The new Volkswagen Acoustics Centre in Wolfsburg

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Introduction

The new Acoustics Centre [1] was built around 36,000 m^3 of interior space and covering an area of 2,600 m^2. It provides enough room for 2 four-wheel drive roller test beds, 1 tyre noise test bed, 2 engine-acoustics test benches, 1 drive train test bed and 1 window test facility. All test stands are designed as semi-anechoic rooms. The three former test beds meet the stricter VW-requirements, which exceed the ISO 3745 [2], due to innovative anechoic wall linings consisting of Broadband Compact Absorber BCA [3] with a partly Asymmetrically Structured Absorber ASA [4]. The VW-requirements of the sound level drop measurements for the roller test beds are ± 1 dB for 100 Hz to 16 kHz and ± 2.5 dB for 40 Hz to 80 Hz for third octave bands and Precision Class 1 for sine measurements according to the standard [2].

Roller Test Beds

The exterior measuring hall is used for acoustical optimisations and to measure the pass-by noise of road vehicles [5]. A rectangular parallelepiped measuring surface with the dimensions 13 x 8 x 5 m was defined around the roller test bed, within which the quality of the freefield properties had to be verified. With up to 9 m of path length, the room meets the requirements for Precision Class 1 from 40 Hz. To verify the freefield properties at the microphone positions, the sound level drop on 11 paths was determined in a quarter of the room, i.e. for 10 m of the room length at intervals of 1 m on the 7.5 m paths. The paths led radially from the test source through the 7.5 m reference points at a height of 1.2 m. The deviations from 100 Hz up to 16 kHz remained within the narrow tolerance of only ± 1 dB. The ± 2.5 dB deviation was met for 50 Hz up to 9 m and for 40 Hz up to 8 m in the direction of the end wall along the 7.5 m path.

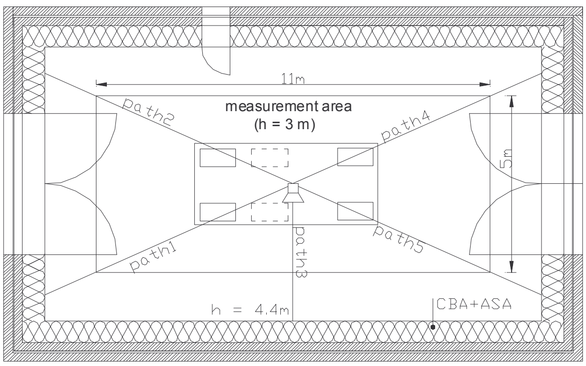

Figure 1: Ground plan, measuring surface and measuring paths of the four-wheel drive test bed.

The four-wheel drive test bed and the rolling noise test bed are very similar, but are used for different measuring tasks. Figure 1 shows the ground plan, the rectangular parallelepiped measuring surface and the measuring paths of the four-wheel drive test bed. A view of the hemi-anechoic room is shown in Figure 2. The sound level drop measurements were taken on diagonal paths through a 10 x 5 x 3 m large rectangular parallelepiped measuring surface. Within the virtual measuring surface in Figure 1, the room meets the requirements of [4] from a lower cut-off frequency of 50 Hz up to 4.5 m on the five measuring paths. For the frequency range of 100 Hz to 16 kHz, the deviations of ± 1 dB from the theoretical freefield properties are also fulfilled.

Figure 2: Four-wheel roller test bed with cooling fan.

Engine and Drive Train Test Beds

The relatively small measuring rooms have numerous installations. Compared to the larger roller test beds, these test beds had to meet the acoustic requirements in terms of the freefield properties according to [2] from 63 Hz. The use of werely 25 cm thick BCA modules was especially beneficial in the smaller test rooms, not only because they are subject to relatively high loads of wear, damage and dirt but also because the drive shafts to the electric motors in the adjacent rooms are located as close as possible to the walls. Benefits in space are also provided by the ventilation shafts that are completely integrated into the suspended ceiling with outlet vents on the room side. The suspended ceilings are lined with sound absorbing ASA, into which the air vents and sound-absorbing lamps are integrated.

In the drive train test bed, Figure 3, the engines are mounted at 1.40 m above the reflective floor. Due to the various special installations and equipment beds in the room it was not possible to carry out a test along diagonal measuring paths. Instead, the test was performed according to the “enveloping surface” method in accordance with [2, Appendix B] with a test sound source. “Freak” values in the sound level differences between the two hemispheres at individual frequencies indicate reflections from the installations or from unlined engine supports. If these surfaces are also covered with sound-absorbing material and measuring positions close to the installations are avoided, it is also possible to carry out one-third octave precision measurements down to 50 Hz.

In the engine test beds the engine is mounted on four supports at a height of 1.20 m above the reflective floor. The drop in the sound level was measured on five paths that extend radially from a central source position into the upper corners of the room. During this process, deviations were recorded which can clearly be assigned to reflections and interferences from the installations described, which influence the free field. Nevertheless, in these small rooms the values remained within the permissible tolerances specified in [2] for Precision Class 1 at 63 Hz up to a measuring radius of approximately 2 m, at 100 Hz up to 3 m and above 100 Hz even up to 3.5 m.

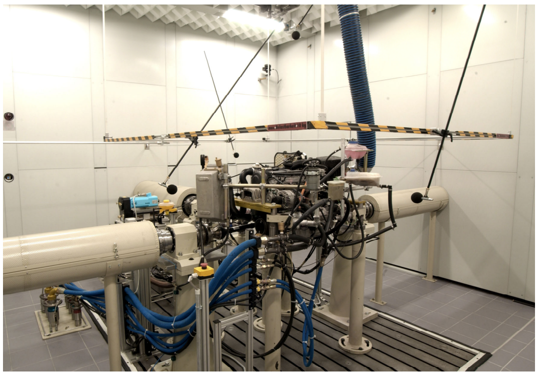

Figure 3: Drive train test bed with wall and ceiling linings.

Window Test Bed

The receiving room is designed as a semi-anechoic room. However, if sound power or window tests in accordance with [6] need to be carried out, a reverberation booth can be installed in the receiving room. The source room, which is located next to the receiving room, is connected on the wall side via the above-mentioned test opening with a maximum of 10 m^2. The second transmitting room is connected to the basement via a test opening. If the test sound sources are arranged on the reflective floor, the freefield conditions according to [7] are fulfilled for third-octave measurements from 125 Hz. In spite of the relatively large surfaces which could not be lined with BCA modules, it was possible to meet up to 2.75 m, 1.75 m and 2.25 m at 63 Hz, 80 Hz and 100 Hz freefield conditions.

Summary

The Acoustics Centre presented impressively underlines the high demands that Volkswagen places on development quality with regard to noise and vibration comfort. For all acoustic test beds, the sound level drop test proves their suitability in accordance with [2]. Figure 4 exemplarilly shows the sound level drop of a measuring path in the exterior noise measuring hall. For comparison, however, Figure 5 shows a result for the same measuring path for narrow-band excitation. These exemplary results have brought a break- through in designing anechoic rooms for all uses with novel acoustic linings [8] which take only a fraction of raw volume required for conventional porous or fibrous absorber wedges of one kind or another.

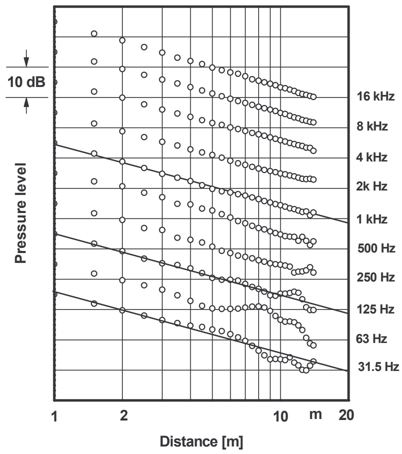

Figure 4: Sound level drop for third octave bands [5] on path 1 in the exterior noise measuring hall.

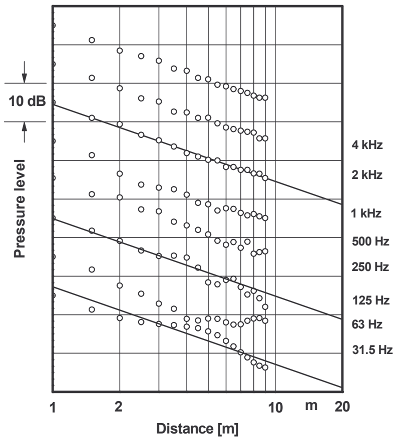

Figure 5: Sound level drop for sine measurements [5] on path 1 in the exterior noise measuring hall.

References:

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